LOGISTICS MANAGEMENT INSTITUTE

PRIME

Power Requirements for Installations and Military Encampments

Maintenance Manual
Version 2.1

UNCLASSIFIED

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The Army uses prime power – large, mobile generators – in its rear areas to bridge the gap between commercial power and tactical generators. When supplying concentrations of Army units, prime power is less vulnerable than commercial power and demands less fuel and maintenance than tactical generators.

The Engineering and Housing Support Center of the U.S. Army Corps of Engineers procures, operates, and maintains the Army's prime power equipment. Power Requirements for Installations and Military Encampments (PRIME) is the model that the Center uses to calculate prime-power requirements for selected Army units and facilities in specific-wartime scenarios.

Users can operate, understand, and maintain PRIME at a number of levels. An end user can operate PRIME simply by following the instructions on the screen. A more sophisticated user may wish to examine the underlying algorithms. Similarly, we have made it possible for the maintenance programmer to update PRIME periodically by revising only the static data files, without having to revise and recompile any of the executable machine programs. At the next level, a maintenance programmer who wishes to change PRIME can examine the program's source code and revise the program's capabilities by editing and recompiling the source code.

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19. ABSTRACT (continued)

We have aimed this maintenance manual primarily at the maintenance programmer who will periodically update PRIME's data files. However, the manual also contains information for the programmer who needs to examine and revise PRIME's source code.

PRIME
POWER REQUIREMENTS FOR INSTALLATIONS AND MILITARY ENCAMPMENTS

Version 2.1 Maintenance Manual

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PREFACE

This maintenance manual conforms to DoD Standard 7935A: *DoD Automated Information Systems Documentation Standards.* Hardware requirements are detailed in Section 3.1. Section 5 provides detailed instructions on how to update the Power Requirements for Installations and Military Encampments data files.

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LMI

Summary

PRIME: POWER REQUIREMENTS FOR INSTALLATIONS AND MILITARY ENCAMPMENTS

Version 2.1 Maintenance Manual

The Army uses prime power – large, mobile generators – in its rear areas to bridge the gap between commercial power and tactical generators. When supplying concentrations of Army units, prime power is less vulnerable than commercial power and demands less fuel and maintenance than tactical generators.

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Users can operate, understand, and maintain PRIME at a number of levels. An end user can operate PRIME simply by following the instructions on the screen. A more sophisticated user may wish to examine the underlying algorithms. Similarly, we have made it possible for the maintenance programmer to update PRIME periodically by revising only the static data files, without having to revise and recompile any of the executable machine programs. At the next level, a maintenance programmer who wishes to change PRIME can examine the program's source code and revise the program's capabilities by editing and recompiling the source code.

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FIGURES

SECTION 1

GENERAL

1.1 PURPOSE OF THE MAINTENANCE MANUAL

Per DoD Standard 7935A

> The objective of this Maintenance Manual for the *Power Requirements for Installations and Military Encampments (PRIME) model* is to provide maintenance programmers with the information necessary to maintain the system effectively.

1.2 PROJECT REFERENCES

1.2.1 Purpose and Uses of the System

PRIME is a computer model that calculates peak electric power requirements for both permanent and temporary Army installations. We developed PRIME to estimate the Army's requirements for prime-power generators, i.e., mobile generators that produce 500 kilowatts (kW) or more of power. The Army previously estimated its prime-power requirements by using a general planning factor of 0.7 kW per person. That factor, however, does not take into account the wide variance in power requirements among different units.

PRIME provides users with the ability to define temporary bases[1] consisting of standard Army units and facilities, and permanent installations. It calculates the electrical power requirements of temporary bases by combining the estimated peak loads of their component units and facilities. PRIME also estimates the electric power requirements of domestic Army installations during mobilization.

Maintenance of PRIME consists of (1) updating the data on Army electricity-consuming equipment and (2) recalculating the peak electrical loads of standard Army units and facilities. We recommend that such updating be carried out at least

[1]The model name uses the term *Military Encampments* rather than *bases* for the sake of the acronym.

every 2 years. A good milestone for PRIME maintenance is a major update of the Army's tables of organization and equipment (TO&Es).

PRIME has two components: one calculates power requirements for scenarios outside the continental United States (OCONUS) and the other calculates mobilization power requirements within CONUS.

PRIME operates on IBM PC™ and IBM-compatible personal computers (PCs) running either the PC-DOS™ (Personal Computer-Disk Operating System) or MS-DOS™ (MicroSoft-Disk Operating System). Operating system documentation is provided by the Army.

1.2.2 Project Sponsor

The PRIME model was prepared for the Prime Power Directorate (PPD) of the Engineering and Housing Support Center (EHSC) by:

Logistics Management Institute (LMI)
6400 Goldsboro Road
Bethesda, MD 20817-5886

under Task AR805 pursuant to DoD Contract MDA903-85-C-0139.

1.2.3 Users and Processing Centers

We expect engineer planners at the major command (MACOM) level, Department of the Army (DA) level, and installation level to be the major users of PRIME. However, since PRIME runs on stand-alone PCs, it can be used by anyone with authorized access to the input data (most of which are classified) and with the necessary (cleared) hardware.

1.2.4 Previous Publications

a. User Manual

Since PRIME operates on stand-alone PCs, it does not require a user manual.

b. End-User Manual

LMI has published an end user manual: LMI Report AR805R2, *PRIME – Power Requirements for Installations and Military Encampments; Version 2.1*

End-User Manual, Salthouse, Robert W., Jeffrey Hawkins, and Douglas M. Brown, August 1989.

c. Computer Operation Manual

PRIME runs on IBM PCs and IBM-compatible PCs. The Army provides the documentation for those systems as it is published.

d. Other Documentation

Further information on the mission of prime power and the methodology used in constructing the model are contained in LMI Report AR805R1, *Prime Power: Filling the Army's Electric Power Gap,* Salthouse, Robert W., Jeffrey Hawkins, Douglas M. Brown, and Carl F. Stout, January 1989. (The original prototype model was named the Prime Power Requirements Model.)

1.3 TERMS AND ABBREVIATIONS

The acronyms used in this guide are listed in Appendix A.

SECTION 2

SYSTEM DESCRIPTION

2.1 SYSTEM APPLICATION

2.1.1 The OCONUS Modules

The OCONUS modules of PRIME calculate wartime overseas electric power requirements. Their input consists of unit names, Standard Requirement Codes (SRCs), and destinations from a Time Phased Force Deployment List (TPFDL) for a particular scenario. For each scenario, PRIME requires the name of the MACOM, the operation plan (OPLAN) identifier, and whether host nation support is expected. The end user must also enter data on the echelon, theater location, movement frequency, and host nation support of each destination in the TPFDL. PRIME creates input data files in dBASE III PLUS™ format. Since the OCONUS input data are normally classified, the input files are also classified.

PRIME's OCONUS modules also generate classified output in dBASE III PLUS format. Output data consist of location, movement frequency, and electric-load specifications for each destination. The output files also contain header data describing the scenario.

2.1.2 The CONUS Modules

The CONUS modules of PRIME calculate prime-power requirements for domestic mobilization. The input to PRIME for each domestic installation with a mobilization mission consists of existing load characteristics (peak load and maximum substation capacity) and expected mobilization population. The user can enter data for either the Training and Doctrine Command (TRADOC) or Forces Command (FORSCOM). CONUS input data may or may not be classified.

The output from the CONUS modules consists of estimates of the prime power required to meet installation peak loads. PRIME stores both input and output data for the CONUS scenarios on a single file. Like the OCONUS data files, the data are

also in dBASE III PLUS format. If the input data are classified, the input/output data files are classified.

2.2 SYSTEM ORGANIZATION

2.2.1 Program and Program Data Files

The OCONUS and CONUS components of PRIME reside on three 5¼-inch 360-kilobyte (Kb) floppy diskettes. The two OCONUS disks contain the following program files and static data files:

- Program files:
  - PRIME1.EXE : Main menu (and data drive specifier)
  - IN_BASE.EXE : Input/edit OCONUS scenario data
  - IN_FILE.EXE : Import dBASE-format data files
  - CALC_BAS.EXE : Calculate OCONUS-scenario peak load
- Static data files:
  - UNIT.TXT : Unit name/SRC data for input
  - INST.TXT : Facility name/ID data for input
  - LOAD.DAT : Army unit electric load data
  - I_EMPTY.BAK : Empty input file (dBASE format)
  - O_EMPTY.BAK : Empty output file (dBASE format)

The single CONUS disk contains the following files:

- Program files:
  - PRIME2.EXE : Main menu (and data drive specifier)
  - CALC_MOB.EXE : Input/calculate CONUS peak load
- Static data files:
  - TRADOC.BAK : TRADOC installation data (dBASE format)
  - FORSCOM.BAK : FORSCOM installation data (dBASE format)

The PRIME program files (those with the .EXE extension) are executable files compiled using Turbo Pascal Version 5.0™. We distinguish the static program data

files from the dynamic input/output data files. The former contain data that are unchanged by users, while the latter contain data that change when the program is run. The program data files with a .TXT extension are in American Standard Code for Information Interchange (ASCII) format. The data file with a .DAT extension is a Pascal-format binary data file (to save space and to expedite processing). The program data files with a .BAK extension are dBASE-format files; we deliberately avoided the .DBF extension so that users would not confuse their dynamic data files with the program's static data files. The OCONUS .BAK files are empty and are used solely as templates to create new data files with the correct dBASE structure. The CONUS .BAK files are templates that also contain peacetime installation data; those files are copied onto the user's data disk to serve as the CONUS input/output data files.

Figure 2-1 illustrates the logical organization of the files comprising the OCONUS portion of PRIME. Figure 2-2 illustrates the organization of the CONUS portion. A user starts either the OCONUS or CONUS models by calling a main menu (PRIME1.EXE or PRIME2.EXE, respectively). All of the other program files (those with .EXE file name extensions) are then accessed from that main menu. Users should *not* attempt to access those program modules directly because they require command-line parameters when called.

2.2.2 Input and Output Files

PRIME produces dynamic data files in dBASE format (Version III PLUS) as shown in Figures 2-1 and 2-2. The only dynamic output data file not in dBASE format is the OCONUS exception file, an ASCII file that lists all SRCs from the input file that are *not* on PRIME's list of SRCs. We provide the dBASE file structures and data codes in Appendix B. PRIME's dynamic data files conform to the following naming conventions (the n's correspond to numbers or characters):[1]

- Input/output files:
  - I_nnnnnn.DBF : OCONUS scenario input
  - O_nnnnnn.DBF : OCONUS scenario output
  - X_nnnnnn.TXT : OCONUS exception file (ASCII format)

[1] DOS (Disk Operating System) restricts file names to eight characters plus an optional three-character extension.

- TRADOCn.DBF : CONUS scenario input/output
- FORSCOMn. DBF : CONUS scenario input/output.

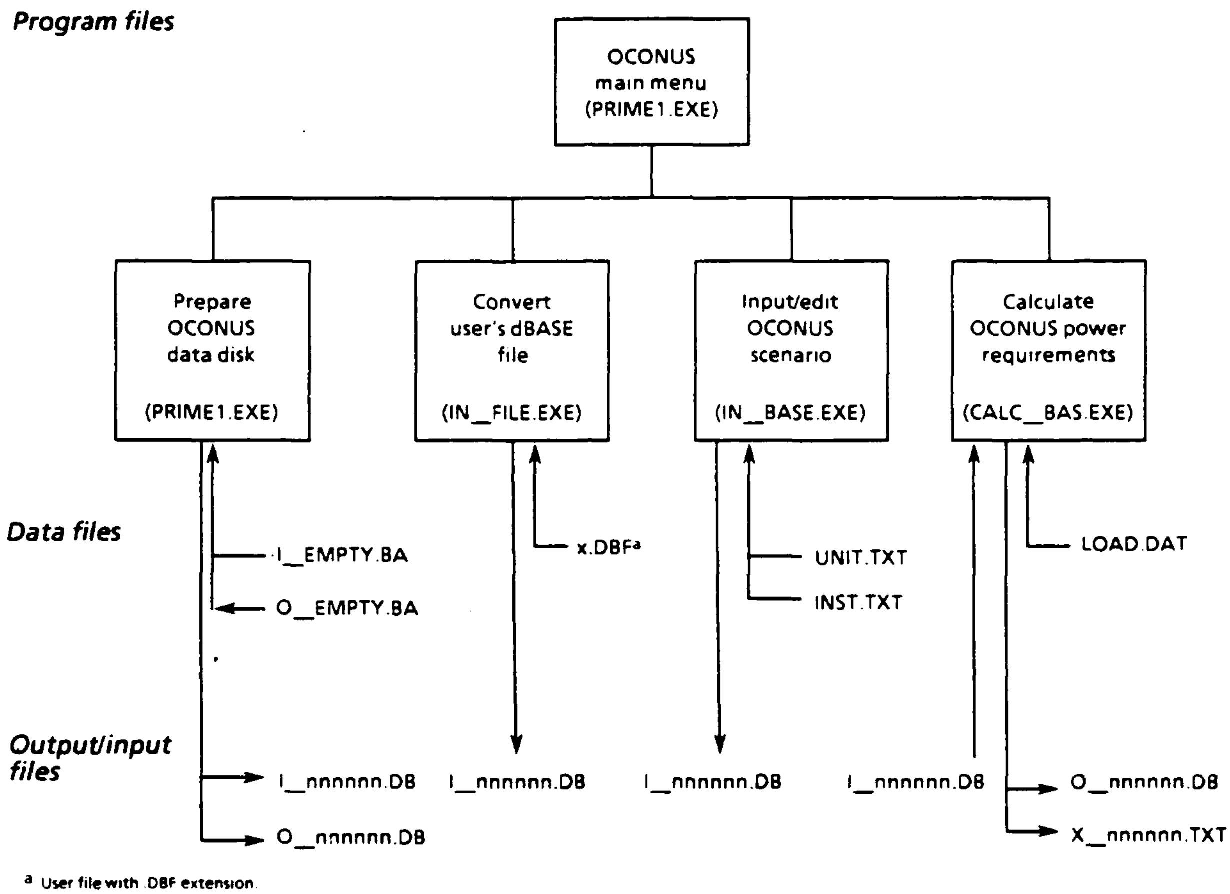


FIG. 2-1. LOGICAL ORGANIZATION OF THE OCONUS PRIME MODEL FILES

PRIME can estimate electric power requirements for both OCONUS and CONUS. In both cases, PRIME takes the user through three stages. First, the user must use PRIME to prepare a blank storage media to receive the data input/output files (using floppy diskettes or other removable storage devices; users must never store classified input or output data on a fixed hard disk). Second, the user must input the required data,[2] and third, the user should ask PRIME to calculate power requirements for that specific scenario. The CONUS module of PRIME integrates input and calculation into one routine.

[2]Either manually via the input module or automatically via the dBASE convert module.

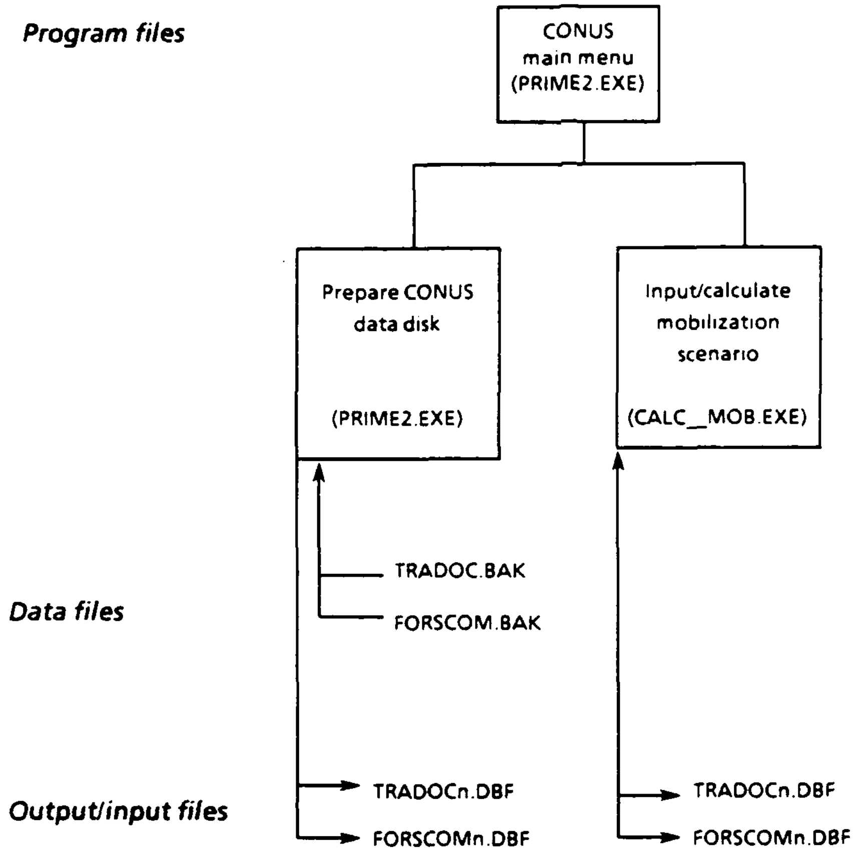


FIG. 2-2. LOGICAL ORGANIZATION OF THE CONUS PRIME MODEL FILES

2.2.3 Interfaces to Other Systems

PRIME works on stand-alone PCs with internal communications paths and does not interface directly with any other system. However, the OCONUS portion of PRIME can interface indirectly with the Worldwide Military Command and Control System (WWMCCS) by downloading data from WWMCCS into a dBASE file with a specific structure and then converting that file into a PRIME input file.

> **WARNING: WWMCCS data are CLASSIFIED. All removable disks used in the transfer process must be entered in the classified log. WWMCCS data must not be stored, even temporarily, on a fixed hard disk.**

Using the same process, PRIME can also interface indirectly with the Planning Resources of Logistics Units Evaluator (PROLOGUE) via an intermediate dBASE file. PROLOGUE is a computer system developed by the Army's Logistics Evaluation Agency (LEA) to analyze the logistics requirements of deployed units. An advantage of using PROLOGUE data as input for PRIME is that LEA has already downloaded unit data for select OPLANs from WWMCCS and has edited these data for completeness and accuracy.

2.2.4 Participating Organizations

Figure 2-3 shows the relationships of PRIME to the other organizations that interact with the model. The PRIME operations and update cycle requires the participation of several organizations. The end user is not required to update the model or its data files; PPD/EHSC performs that function.

a. PPD/EHSC

The model sponsor, PPD/EHSC, reviews the model's outputs. In coordination with the MACOMs, PPD takes the necessary steps to procure prime power. It determines where power units should be assigned and how to staff them and is responsible for coordinating with all MACOMs to receive and consolidate PRIME outputs. It is also responsible for periodically updating and otherwise maintaining the model.

b. MACOMs

MACOMs choose the scenarios, produce the inputs and outputs of PRIME, confirm the validity of the output with PPD, and use those data for their planning. MACOM engineering staffs may also use PRIME to plan for contingencies not envisioned under current war plans.

c. The Belvoir Engineering Research and Development Center (BERDC)

BERDC is the sponsor of the Belvoir Generator Allocation Program (BGAP). One of the data files of that system is used as a source of power demand data for Army equipment.

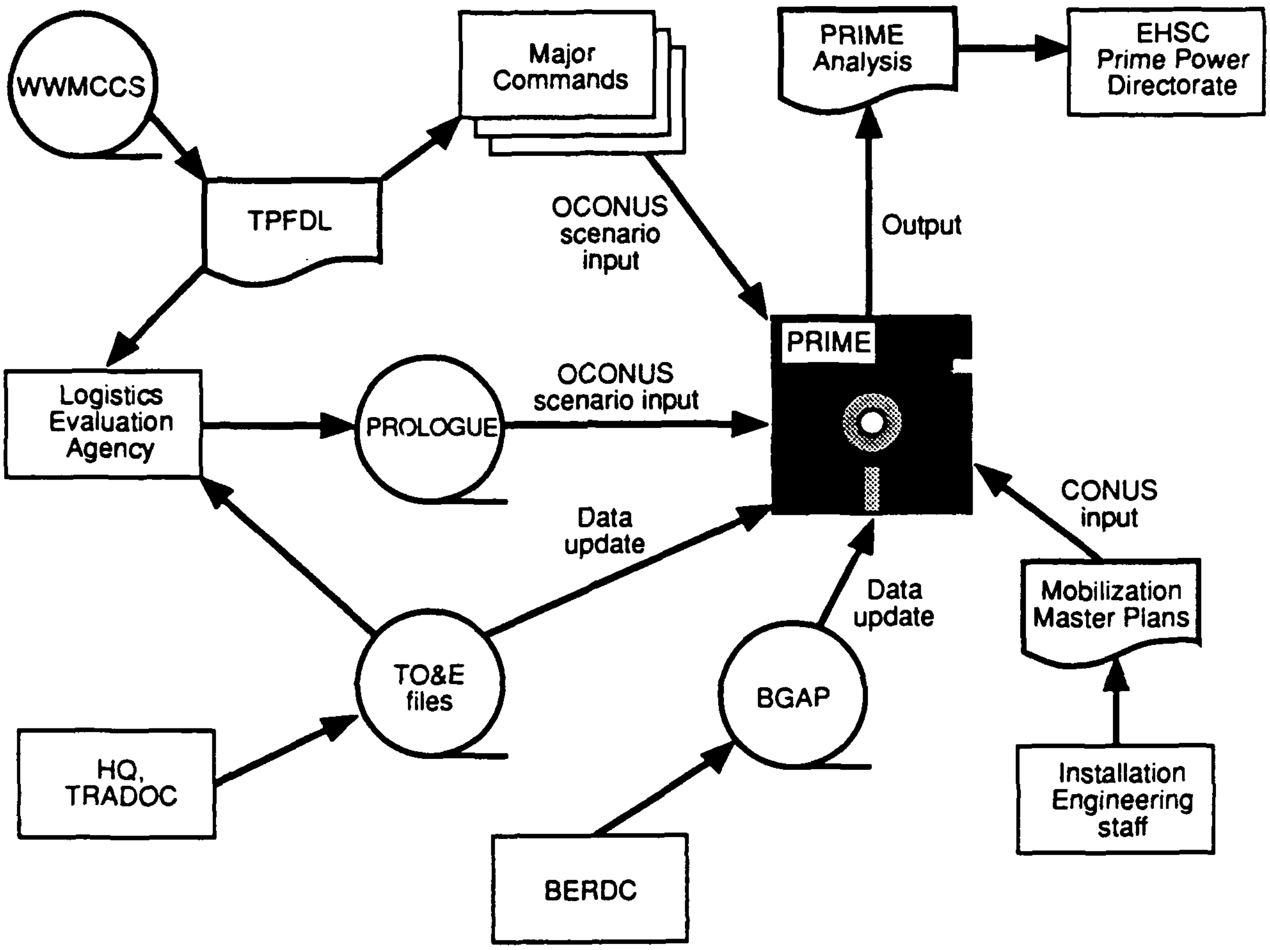


FIG. 2-3. PARTICIPATING ORGANIZATIONS AND SYSTEMS

d. *TRADOC*

TRADOC maintains type TO&E files that are a basic data source for periodic maintenance of PRIME.

e. *LEA*

LEA maintains PROLOGUE, a possible source of OCONUS input data.

f. TRADOC and FORSCOM

TRADOC and FORSCOM maintain mobilization master plans for their installations. Those master plans are the basic input data source for the CONUS module of PRIME.

2.3 SECURITY

Since no PRIME program or static data file is classified, the maintenance programmer need not worry about security considerations. However, end users enter classified data during the operation of PRIME. When data from an actual TPFDL are entered, PRIME will generate data files that contain classified information and should never be stored on a disk that cannot be removed from the PC and secured. PRIME allows the user to specify the drive to which the output will be written.

WARNING: When entering classified data, the PC must be cleared for classified operation up to the level of the data to be used. All copies of data diskettes or printouts containing classified data must be entered in the classified log.

In order to avoid generating classified output, we recommend that maintenance programmers use dummy data to test PRIME during the maintenance process. PRIME was developed using dummy data, although we tested it with actual classified data twice during development. A dummy data file of 15 to 20 unit types can be created manually in a few minutes.

2.4 SYSTEM REQUIREMENTS CROSS-REFERENCE

Not applicable.

SECTION 3

ENVIRONMENT

3.1 EQUIPMENT ENVIRONMENT

PRIME requires an IBM PC or IBM-compatible microcomputer with at least 640 Kb of random access memory (RAM). The computer can have any type of removable read/write mass storage drives. The user's computer must be cleared for classified work before processing classified data. Computers used for maintaining the model need not be cleared, however, as long as classified data are not used to test the model.

3.2 SUPPORT SOFTWARE

You must use PC-DOS™ or MS-DOS™ Version 2.0 or higher to run the model. The model is delivered on three 5¼-inch 360-Kb floppy diskettes formatted with MS-DOS Version 3.31.

In addition to DOS, the maintenance programmer needs the following software:

- A floppy diskette containing the PRIME Version 2.1 maintenance files. That disk contains Pascal and dBASE programs and data files that can help maintain the PRIME data files. We explain the use of those programs in Sections 4 and 5. The maintenance files are listed in Section 4.4.
- dBASE III PLUS or a compatible database package to update CONUS data, to revise dBASE-format static data files, and to download data from TO&Es.
- A text editor to update the ASCII static data files. We found Lotus 1-2-3 Version 2.1™ a useful tool for handling data in fixed row (record) and column (field) formats.
- A tape-to-disk conversion program for downloading TRADOC TO&E tapes.
- Although not necessary for routine maintenance, Turbo Pascal Version 5.0 and Topaz™ Version 2.5 in the event you want to modify PRIME source files and compile new executable program files. It is difficult to compile the PRIME source files using another Pascal compiler since we have made liberal use of functions and procedures unique to Turbo Pascal. Topaz

provides functions and procedures to create and work with dBASE-format files.

3.3 DATABASES

3.3.1 General Characteristics

a. *OCONUS Data Files*

The OCONUS modules read from (but never write to) the following unclassified static data files. Those files may be stored on floppy diskette or any other removable storage medium.

- UNIT.TXT is an ASCII file containing the names and SRCs of more than 1,300 active Army unit types.
- INST.TXT is an ASCII file containing the names and identification codes of those standard Army facilities that use electric lighting.
- LOAD.DAT file holds electrical consumption data for all of the units and facilities in UNIT.TXT and INST.TXT. LOAD.DAT is a binary file that uses Turbo Pascal's data format. The maintenance program, CNV_BGAP, creates LOAD.DAT as explained later. It is essential that LOAD.DAT contain exactly the same units and facilities as are in UNIT.TXT and INST.TXT combined.
- I_EMPTY.BAK and O_EMPTY.BAK are empty dBASE-format files that contain no data. PRIME never writes directly to those files; it uses them to create dynamic data files with the correct dBASE data structure. That is, it copies them to the user's data disk and renames them to create the OCONUS input and output data files.

The OCONUS modules write to and read from any number of the following dynamic input and output data files (n stands for any character). Each OCONUS input file must have a paired output file whose name is identical except for the first character. The files must be stored on floppy diskette or any other removable medium separate from the medium holding the program and static data files.

- I_nnnnnn.DBF are dBASE format files that hold scenario-specific OCONUS input information.
- O_nnnnnn.DBF are dBASE format files that hold PRIME's OCONUS output information.

b. CONUS Data Files

The CONUS modules read from (but never write to) two static data files: TRADOC.BAK and FORSCOM.BAK, which may be stored on floppy diskette or any other removable storage medium. They are dBASE format files that contain peacetime population and electrical consumption data for all TRADOC and FORSCOM installations. Although the two files also contain blank fields for the user's input data, PRIME never writes directly to those files. Instead, it renames and copies them onto the user's data disk, where they become the CONUS input/output data files.

The CONUS modules both write to and read from any number of TRADOCn.DBF and FORSCOMn.DBF dynamic input/output data files (n stands for any number). TRADOCn.DBF and FORSCOMn.DBF are dBASE format files that hold static installation data, user-entered (dynamic) input data, and PRIME-calculated output data. PRIME allows for multiple files (using different values of n) to permit the user to create multiple mobilization scenarios.

c. Security Considerations

As a maintenance programmer, you normally need not worry about security considerations. PRIME never writes to the static program data files and they contain no classified data.

WARNING: If you test the original or updated program with actual classified data, you must use a cleared PC. Your dynamic input and output files must be included in the classified log and treated accordingly. The disks holding the PRIME program and static data files should be write-protected.

3.3.2 Organization and Detailed Description

Tables 3-1 through 3-6 show the data structure of each of PRIME's static and dynamic data files. You can examine the ASCII (.TXT) files directly with any text editor (or by using the DOS command: type x.TXT, where x is the name of the file you wish to read). You can examine the dBASE-format files with dBASE III PLUS or a compatible database package.

TABLE 3-1

UNIT.TXT STRUCTURE

Data element	Bytes
SRC	9
Unit name	28
Total	37

Note: File does not use separations between elements.

TABLE 3-2

INST.TXT STRUCTURE

Data element	Bytes
Facility-type ID	9
Facility name	28
Total	37

Note: File does not use separations between elements.

TABLE 3-3

LOAD.DAT STRUCTURE

Data element	Pascal data type[a]	Bytes
SRC	String [9]	10
SumkW	Array [1..4] of Real	24
SumKVAR	Array [1..4] of Real	24
MaxLoad	Array [1..4] of Real	24
Population	Integer	2
Total		84

[a] Using Pascal notation

TABLE 3-4

OCONUS INPUT FILE STRUCTURE

Field	Field name	Type	Width	Dec[a]
1	BASE_NUM	Numeric	4	–
2	BASE_NAME	Character	28	–
3	ECHELON	Numeric	1	–
4	LOCATION	Numeric	1	–
5	MOV_FREQ	Numeric	2	–
6	HOST_NTN	Logical	1	–
7	UNIT_NAME	Character	28	–
8	SRC	Character	9	–
9	UNIT_QTY	Numeric	3	–
Total			78[b]	

[a] Decimal places.

[b] Total includes hidden delete field.

At the start of the OCONUS input process, PRIME invokes IN_BASE.EXE, opens UNIT.TXT and INST.TXT, reads the unit and facility identification data into RAM, and closes the files. PRIME then presents that data to the user via "pick list" windows. PRIME reads the data from those static data files, rather than from the keyboard for two reasons: (1) to make input easier and (2) to limit user entries to correct choices (i.e., that set of standard units and facilities for which PRIME has electric load data in LOAD.DAT).

At the start of the OCONUS calculation process, PRIME invokes CALC_BAS.EXE, opens LOAD.DAT, reads the electric-load data into RAM, and closes the file. PRIME then relates that data to the SRCs in the input file (I_nnnnnn.DBF) one record at a time. We illustrate the methodology in detail in Appendix C.

TABLE 3-5

OCONUS OUTPUT FILE STRUCTURE

Field	Field name	Type	Width	Dec[a]
1	BASE_NUM	Numeric	4	–
2	BASE_NAME	Character	28	–
3	ECHELON	Numeric	1	–
4	LOCATION	Numeric	1	–
5	MOV_FREQ	Numeric	2	–
6	NUM_UNITS	Numeric	3	–
7	POPULATION	Numeric	7	–
8	H50_KW	Numeric	11	3
9	H60_KW	Numeric	11	3
10	H400_KW	Numeric	11	3
11	DC_KW	Numeric	11	3
12	TOT_KW	Numeric	11	3
13	H50_PF	Numeric	5	3
14	H60_PF	Numeric	5	3
15	H400_PF	Numeric	5	3
16	DC_PF	Numeric	5	3
17	TOT_PF	Numeric	5	3
18	H50_MAXKW	Numeric	7	3
19	H60_MAXKW	Numeric	7	3
20	H400_MAXKW	Numeric	7	3
21	DC_MAXKW	Numeric	7	3
22	TOT_MAXKW	Numeric	7	3
23	HOST_NTN	Logical	1	–
Total			163[b]	

[a] Decimal places.

[b] Total includes hidden delete field.

TABLE 3-6

CONUS INPUT/OUTPUT FILE STRUCTURE

Field	Field name	Type	Width	Dec[a]
1	FORT_ID	Numeric	3	–
2	FORT_NAME	Character	30	–
3	AVG_LOAD	Numeric	10	1
4	PEAK_LOAD	Numeric	10	1
5	MOB_LOAD	Numeric	10	1
6	MAX_LOAD	Numeric	10	1
7	BACK_LOAD	Numeric	10	1
8	PP_REQT	Numeric	10	1
9	NORM_POP	Numeric	10	–
10	MOB_POP	Numeric	10	–
Total			114[b]	

[a] Decimal places.

[b] Total includes hidden delete field.

The CONUS modules of PRIME read installation population and average electric-load data from either TRADOC.BAK or FORSCOM.BAK, depending on whether the user has chosen to analyze TRADOC or FORSCOM prime-power requirements. However, most of the data that PRIME uses in its calculations are entered from the keyboard.

IMPORTANT: If you modify the structure of any static or dynamic data files without modifying the PRIME program code, PRIME will no longer reliably read from or write to those files. PRIME will either cease to work or will yield erroneous results.

SECTION 4

SYSTEM MAINTENANCE PROCEDURES

PRIME can be updated by revising the static data files without changing the compiled program files. PRIME's executable program files contain no hard-coded data that must be periodically updated and recompiled.

4.1 CONVENTIONS

4.1.1 File Extensions

A DOS file specification consists of two parts: a file name and a file extension (the path name, which includes the file specification, also includes the drive specifier and directory path). PRIME's three-character file extensions denote the type of file, using the following conventions (where *x* represents the file name):

- *x.PAS – Program source code.* These ASCII files were compiled using Turbo Pascal Version 5.0 to produce .EXE files with the same file names. (Source code is not included on the end user disks; maintenance programmers will normally not need source code.)

- *x.EXE – Executable binary program files.* These compiled Pascal files are invoked directly from DOS (although for most PRIME program files, the name must be followed by a parameter line to work properly).

- *x.TXT – ASCII data files.* Most of PRIME's .TXT files contain static data that are read by various PRIME program (.EXE) files. The program files check for the presence of the necessary static data files and terminate if they do not find them in the same directory. One .TXT file contains dynamic ASCII data consisting of a list of SRCs that are in the input data file but not in LOAD.DAT (and UNIT.TXT).

- *x.DAT – Binary static data file.* The binary code used to store data in the .DAT data file follows Turbo Pascal's internal data storage formats. Like the .TXT files, it is read by an .EXE program file.

- *x.DBF – dBASE-format files.* While PRIME is not a dBASE program, it nevertheless reads and creates dBASE-format dynamic data files. These .DBF files can be read by dBASE or compatible database programs just like a file created in dBASE.

- *x.PRN – ASCII data files.* These files are temporary maintenance data files. The .PRN extension makes it easier to import them into Lotus for inspection and possible modification. Files with the .TXT extension can also be imported into Lotus, but the extension must be explicitly specified.

4.1.2 dBASE-Format File Data Structures

Appendix C provides details on the dBASE data structures found in PRIME's dynamic data files.

4.1.3 Standard Data Elements

Following are definitions of PRIME's standard data elements:

- *Base:* A temporary collection of Army units and facilities in an area not exceeding 2 to 3 square miles.
- *Unit:* Standard Army unit, defined by nine-character SRC. A unit consists of personnel and the essential equipment they need to perform their mission.
- *Facility:* A building or other physical structure located on a base.
- *Real power:* The rate at which electric energy is consumed or work is done. PRIME measures real power in thousands of watts, or kilowatts.
- *Reactive power:* The degree to which voltage and current are out of phase (for alternating current). Reactive power is measured in kilovolt-amperes (kVAR).
- *Total power:* The simple product of full voltage and full current, measured in kilovolt-amperes. Total power is abbreviated kVA to distinguish it from reactive power. If reactive power is greater than zero, then total power exceeds real power.
- *Peak load:* The maximum amount of power required; peak power is usually less than the connected load – the simple sum of all equipment loads – because all pieces of equipment are rarely operating at the same time.
- *Operation plan:* The specific wartime plan, according to which certain units are expected to inhabit specific locations to meet expected wartime conditions. OPLANs are classified.
- *Host nation support:* Agreements have been negotiated with certain of our allies to provide infrastructure and other support to U.S. Army units in time of war. PRIME considers host nation support equivalent to commercial electric power.

4.2 VERIFICATION PROCEDURES

We verified the original PRIME model by duplicating the inputs and calculations in Lotus 1-2-3. We also recommend running the model through its paces to make sure that all of the pick lists and other features work after modification as they worked before. That is, we recommend that a check for obvious errors (see Section 4.3 for possible error messages) be conducted.

4.3 ERROR CONDITIONS

PRIME uses a variety of error-handling techniques. In the event of an error or malfunction, it will usually display a message informing the user about the error. It then ceases operations at the current level and returns to a higher level. That is, if PRIME is in one of the modules when an error occurs, it will normally display an error message and then return to the main menu. The following subsections give a description of PRIME's error traps and messages.

4.3.1 Program Files Missing

If one or more of the program files or program data files are missing from the program disk, PRIME will display the names of the missing files and pause until the user presses any key; it will then return to DOS. If that occurs, recopy all of the files from the appropriate OCONUS master program disk back onto your working copy.

4.3.2 Modules Fail to Operate

Whenever you make a choice from the main menu, PRIME invokes one of its subsidiary programs. PRIME has already checked that the program exists before displaying the menu, so any errors introduced while calling a subsidiary program will usually be more subtle than missing files. The following error messages can be displayed on the screen in the event of a module failure:

- *Cannot find file.* This message occurs most commonly if you have removed the program disk after the main menu has been displayed. To resolve the error, replace the program disk in the current drive, usually *A*:.
- *Cannot find path.* Upon receiving this message, check whether the program disk is still in place and whether all of your program files are in the same directory as PRIME1.EXE.

- *Too many files are open.* Occasionally, PRIME has two or more files open (for reading and writing data) at the same time. If you get this message, you must reconfigure your CONFIG.SYS file.
- *DOS denied access to file.* This message indicates that something is wrong with the file. Make a new working copy from the master program disk.
- *Not enough computer memory (640 Kb required).* This message informs you that your machine does not have enough RAM. Install more memory or run PRIME on another PC with at least 640 Kb of RAM.
- *Drive x does not exist on your system.* PRIME has already checked to make sure the data drive exists. This error message indicates either that you have disconnected one of your drives (possibly inadvertently) or that a hardware malfunction exists.
- *DOS error #x.* In the unlikely event that you see this message, refer to your DOS manual for a description of the error.

4.3.3 Attempt to Read the Wrong dBASE File

If you attempt to read a file with the wrong dBASE structure, PRIME will tell you that it "Cannot load A:x.DBF" and will display the correct dBASE structure. Recovery is simple; press any key and then select another file.

4.3.4 Input File Contains No Data

If you attempt to edit (or add data to) a file that has no data in it, PRIME will tell you that the file you have selected "contains no scenario data." Recovery is simple; PRIME will redisplay the pick list of input files and ask you to choose another file.

4.3.5 Sort Errors

The OCONUS Edit Module resorts the units by base and SRC data after you add new or additional units. The following errors can occur during that process:

- *Not enough memory available.* Make sure your computer has at least 640 Kb of RAM.
- *File contains more than 32,767 records.* Your input data file is too large. A scenario file is unlikely ever to reach this size; however, if it does, split the input file into two or more files.

- *Write error during sort; disk is full or contains a bad area.* Check your disk using the DOS command "CHKDSK [drive]." If the disk is full, move some of your files to another disk and try again.

- *Read error during sort; disk probably contains a bad area.* Copy your data files onto a new disk and throw away the old one.

- *Disk or directory is full or disk is locked.* If the disk is full, move some of your files to another disk and try again. Otherwise, make sure your data drive is working properly.

- *Error, unsuccessful sort.* You will only see this message in the unlikely event that an error occurs that is not one of the above.

4.3.6 Other Errors

If an error occurs that does not cause PRIME to display an error message and exit gracefully from the error, first check that your system is set up in accordance with the instructions in Section 3.1 and that your PC and peripherals are in working order. As a last resort, make a new copy of the PRIME program disks and try again. If you still get an unexplained error, you may have to refer to the source code for that program file.

4.4 MAINTENANCE SOFTWARE

The following maintenance programs are included on PRIME's maintenance disk:

- *SRCDUMP.PRG and SRCDUMP2.PRG:* dBASE programs used to create a dBASE file of TO&E data from tape-conversion output.

- *CNV_BGAP.EXE:* Takes as input LIN_CONS.BSE and produces LIN_CONS.DAT, a Pascal-format binary data file for use by CALC_ALL.

- *CALC_ALL.EXE:* Takes as inputs the dBASE file of TO&E data and the LIN_CONS.DAT file and produces an ASCII output file. Simulates peak load for each standard Army unit in the TO&E data files.

- *CNV_LOAD.EXE:* Converts the ASCII output file from CALC_ALL into LOAD.DAT, a PRIME static data file.

- *CNV_SRC.EXE:* Takes as input TO&E unit name data and creates the static data file UNIT.TXT.

- *PRIMEBAK.BAT:* Batch file that copies updated PRIME files onto the three end user disks in the correct order.

4.5 MAINTENANCE PROCEDURES

We recommend that the maintenance programmer first make back-up disks of the PRIME maintenance software before beginning any of the maintenance procedures. Use the DOS command *COPY A:*.** to copy all of the files from the original disks to a new disk. The procedures will be much faster if the programs are copied onto and run from an internal hard disk.

> **WARNING: Do not use a hard disk if you are going to process classified data.**

We explain the rest of the maintenance procedures in detail in Section 5.

SECTION 5

SOFTWARE UNIT MAINTENANCE PROCEDURES

We have designed PRIME so that periodic maintenance is relatively straightforward. You should not have to alter any of the compiled program files (i.e., those with .EXE extensions). The only files that need to be periodically updated are the static data files (i.e., those with .TXT, .DAT, and .DBF extensions).

Sections 5.1 through 5.4 explain the OCONUS model maintenance procedures. Maintenance of the OCONUS model consists of updating two essential data tables: (1) load data for the electricity-consuming equipment used by standard Army units and (2) load data for those standard Army units.

Section 5.5 explains the CONUS model maintenance procedures. Maintenance of the CONUS model consists of updating the peacetime population and electric-load data contained in the TRADOC and FORSCOM static data files.

5.1. UPDATING PRIME'S OCONUS STATIC DATA FILES

5.1.1 Setting Up the System

The first step in updating PRIME is to copy the necessary program files and data files from the PRIME maintenance disks onto your hard disk. To do that, enter the DOS mode on your computer and then create a new directory on the hard disk using the following DOS command:

C:>md\<directory name>

Place the disk labeled *PRIME Version 2.1 Maintenance Disk* in your floppy drive and copy all of the files from that disk into the new directory on your hard disk as follows (we assume that the floppy disk drive is A: and the hard disk drive is C:):

C:>*copy A:*.**

You should now have the following program files in your new directory:

- SRCDUMP.PRG
- SRCDUMP2.PRG
- CNV_BGAP.EXE
- CALC_ALL.EXE
- CNV_LOAD.EXE
- CNV_SRC.EXE
- PRIMEBAK.BAT

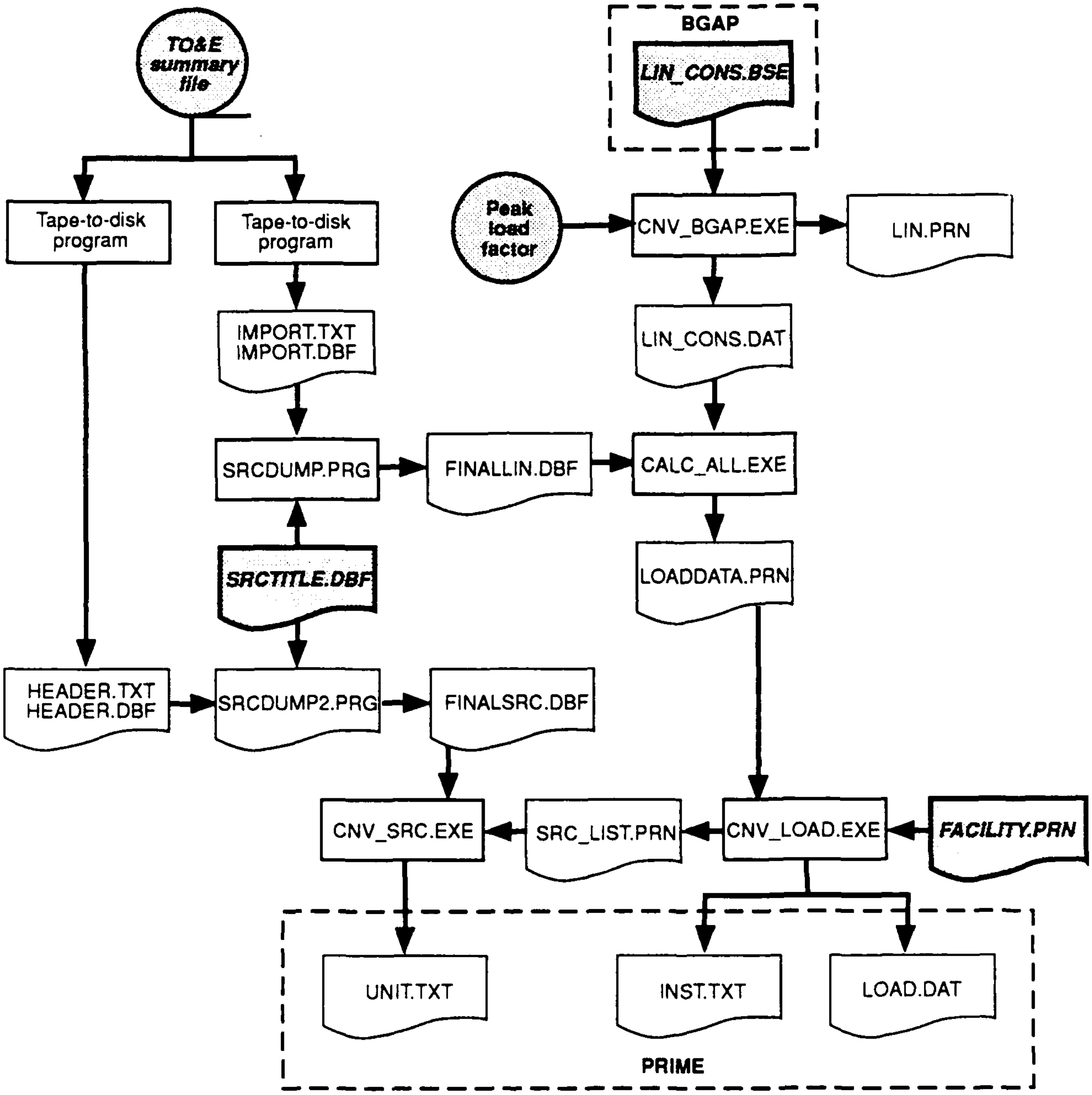
and the following input data files:

- LIN_CONS.DAT
- FACILITY.PRN
- SRCTITLE.DBF

5.1.2 Steps in Maintaining the Data Files

Figure 5-1 illustrates the flow through the data and program files required to update PRIME's OCONUS static data files. The elements shown with a toned background are the system inputs. Normally, you will need to obtain new versions of only one or two of these input data sources.

- *TO&E Summary File:* This is the most important input data source for updating PRIME. It contains data on standard Army TO&Es. From that tape you will have to extract SRCs, SRC names, line identification numbers (LINs), and LIN quantities. Optionally, you can extract unit populations.
- *SRCTITLE.DBF:* This dBASE file contains a list of all current active SRCs. The list should generally equal the SRCs contained in TRADOC's current Unit Quarterly Status Update (UQSU). While you can obtain the raw data from TRADOC, you will have to convert it into the proper dBASE format, following the instructions in Section 5.3.3, Subsection a.
- *LIN_CONS.BSE:* This database contains information on all standard Army electricity-consuming equipment by the LIN and the electrical load characteristics of that equipment. This input is needed only when a significant update has occurred.
- *Peak load factor:* We recommend against changing this value unless you have good reason to do so and that reason is substantiated with a supporting



NOTE: Highlighted elements are inputs.

FIG. 5-1. OCONUS MAINTENANCE FLOW

analysis. The default value is based on our analysis of Army wartime electricity consumption.

- *FACILITY.PRN:* You will probably not need to revise this file. It contains standard Army facility types that require electric lighting. We calculated their electricity requirements based upon square footage and standard lighting factors. The source of our facility data is the Theater Army Construction Automated Planning System (TACAPS), maintained by the U.S. Army Corps of Engineers, Huntsville Division, Huntsville, Ala.

The PRIME maintenance disk contains the versions of LIN__CONS.DAT, FACILITY.PRN, and SRCTITLE.DBF that we used to prepare PRIME Version 2.1. CNV__BGAP.EXE contains the default value of the peak load factor; when that program runs, it gives you the opportunity to accept the default value or to change it. We have supplied the latest version of LIN__CONS.DAT in case LIN__CONS.BSE has not changed, to save you having to run CNV__BGAP as explained in Section 5.2.3.

In the following subsections, we explain each of the OCONUS maintenance steps.

5.1.3 Temporary Data Files

During the OCONUS maintenance process, you will create three temporary ASCII files with a .PRN extension. Two serve as data links between the maintenance programs, and if all goes properly, you can ignore them. However, if you want to check the process in more detail, you can read them. The LIN.PRN file is not read by any of the PRIME maintenance files; it is a list of valid (i.e., electricity-using) LINs created solely for documentation.

We gave those temporary files the .PRN extension to make it easier to load them into Lotus 1-2-3, as follows:

- Invoke Lotus 1-2-3 and bring up an empty spreadsheet. Stay in the <*Home*> position (Cell A1).
- Enter / *File Import Text.*
- Select the .PRN file you want to examine.

You can now read the file more easily than with the DOS *type* command and you can print out the contents to serve as documentation.

The process creates the following three temporary ASCII files:

- LIN.PRN: List of valid LINs.
- LOADDATA.PRN: Electric peak load requirements by frequency and unit.
- SRC_LIST.PRN: List of SRCs extracted from the TO&E summary file.

5.2 UPDATING LIN_CONS.DAT

5.2.1 Purpose of LIN_CONS.DAT

The data in LIN_CONS.DAT are needed only during the maintenance phase of PRIME; the file is not read during end user runs of the model and is not included on the end user disks. The maintenance program CALC_ALL.EXE reads from LIN_CONS.DAT to identify valid (electrical) equipment and to obtain electric-load data. Maintenance programmers need to update LIN_CONS.DAT *only* when a significant change has taken place in the types of equipment assigned to Army units.

To determine whether you should update LIN_CONS.DAT, contact the Tactical Energy Systems Laboratory (U.S. Army Belvoir Research and Development Center, Fort Belvoir, Va. 22060-5606) and ask whether the LIN_CONS.BSE file in the BGAP has been updated significantly since March 1988. BGAP is a model that estimates the tactical generator requirements of Army units; LIN_CONS.BSE is one of BGAP's static data files and forms the primary input for PRIME's LIN_CONS.DAT. LIN_CONS.BSE is a Pascal-format data file with information on the electrical characteristics of standard Army electrical equipment (by LIN).

If you have to update LIN_CONS.DAT, use the maintenance program CNV_BGAP.EXE as explained in Section 5.2.3. Otherwise, use the existing version of LIN_CONS.DAT on the PRIME maintenance disk.

5.2.2 LIN_CONS.DAT Structure

LIN_CONS.DAT is a maintenance data file containing electric-load data for each unique type of electric-powered equipment in the U.S. Army. It has one record per piece of equipment, identified by its unique attribute, the LIN. The data elements are shown in Table 5-1.

LIN_CONS.DAT is a binary data file; each data element is represented in binary rather than ASCII format. The particular binary data encoding scheme is

TABLE 5-1

LIN_CONS.DAT STRUCTURE

Data element	Pascal data type[a]	Bytes
LIN	String [6]	7
kVA	Real	6
kW	Real	6
kVAR	Real	6
Peak load factor	Real	6
Freq	Byte	1
Total		32

[a] Using Pascal notation

that of Turbo Pascal. As Table 5-1 shows, each record in the file is 32 bytes long. Only equipment that requires electric power to operate is included in LIN_CONS.DAT.

A LIN is the standard identifier representing a unique type of Army equipment. It is a six-character alphanumeric identifier represented by Pascal's string type, which consists of an initial length byte, plus 1 byte per character encoded in ASCII. The three electric-load parameters (kVA, kW, and kVAR) are encoded as Turbo Pascal standard real numbers, consisting of 6 bytes each.[1] A Pascal real number can store 11 to 12 significant digits in floating-point (i.e., exponential) notation. The *peak load factor* variable represents the probability that a particular item will be turned on at the peak time of day; it is a percentage encoded as a real number variable. *Freq* is a coded byte representing the frequency at which a particular item of equipment operates: 0 for 50 Hertz (Hz). 1 for 60 Hz, 2 for 400 Hz, and 3 for direct current (DC). (Although 50 Hz is not a normal frequency in the United States, one of the items in the current version of LIN_CONS.DAT is listed as operating at that frequency.)

5.2.3 LIN_CONS.DAT Maintenance Procedures

To update LIN_CONS.DAT, copy CNV_BGAP.EXE and the latest version of LIN_CONS.BIN into the same directory of your working disk. Run the conversion

[1]Section 4.1.3 defines those load parameters.

program by typing *C:>CNV_BGAP* at the DOS prompt. CNV_BGAP will check for the presence of LIN_CONS.BIN and will then ask you to enter the percent peak load factor. Press <Enter> to retain the default factor unless you have good reason to change it. The program then reads in the necessary data from LIN_CONS>BIN; eliminates duplicate LINs; makes its calculations; and writes the new data, including the peak load factor variable, to LIN_CONS>DAT.

If the old version of LIN_CONS.DAT is in the same directory, CNV_BGAP will overwrite it; otherwise, CNV_BGAP will create a new LIN_CONS.DAT file.

5.2.4 Calculation of LIN_CONS.DAT Data

CNV_BGAP does more than merely extract data from BGAP. It calculates kW and kVAR from the power factor and phase data in BGAP, assigns 0 kW to all power supplies, and adds the percent peak load factor to each item.

CNV_BGAP reads the following data elements from LIN_CONS.BIN: power factor, phase, volts, and amperes. It then calculates the load variables in LIN_CONS.DAT as follows:

$$\begin{aligned}
\text{kVA} &= \text{volts} \times \text{amperes} \times \sqrt{\text{phase}} \\
\theta &= \text{arc cos (power factor)} \\
\text{kW} &= \text{kVA} \times \sin\theta \\
\text{kVAR} &= \text{kVA} \times \text{power factor.}
\end{aligned}$$

Power supplies are pieces of equipment that convert the alternating current produced by prime-power generators into direct current for use by DC equipment. If PRIME included load data for power supplies and DC equipment, it would double-count the required DC loads. Therefore, CNV_BGAP searches the LIN database for all power supplies and sets the kVA, kW, and kVAR of those LINs to zero. That is, we assume that the DC equipment, not the conversion (power supply) equipment, defines the power requirement.

We assigned every LIN item the same peak load factor – 63.5 percent – based on combat experience in Vietnam. We explain the derivation of the peak load factor in Appendix D.

5.3 UPDATING LOAD.DAT

5.3.1 Purpose of LOAD.DAT

The data in LOAD.DAT are required during end user runs of PRIME's OCONUS module. To update LOAD.DAT, you will need TRADOC's most recent TO&E tape plus the current version of LIN_CONS.DAT (see Section 5.2.1). Updating LOAD.DAT requires three steps (excluding the update of LIN_CONS.DAT): (1) read the TO&E tape into a dBASE file, (2) relate LIN data from LIN_CONS.DAT with the TO&E data (and simulate peak unit loads), and (3) convert and combine the results of Step 2 into the LOAD.DAT binary data file. You need the maintenance programs SRCDUMP.PRG and CALC_ALL.EXE to complete the process.

5.3.2 LOAD.DAT Structure

LOAD.DAT is a static data file containing peak electric-load data for each standard Army unit. It has one record per standard Army unit, identified by its unique attribute, the SRC. The data elements are shown in Table 5-2.

TABLE 5-2

LOAD.DAT STRUCTURE

Data element	Pascal data type[a]	Bytes
SRC	String [9]	10
SumkW	Array [1..4] of Real	24
SumkVAR	Array [1..4] of Real	24
MaxLoad	Array [1..4] of Real	24
Population	Integer	2
Total		84

[a] Using Pascal notation

While most of PRIME's static data files are ASCII files (for ease of maintenance), LOAD.DAT is a binary data file to speed processing and reduce storage space. As Table 5-2 shows, each LOAD.DAT record is 84 bytes long. Every nine-character alphanumeric SRC represents a unique Army unit. The electric power variables are represented by arrays, which consist of four Pascal real number types in sequence. Those arrays contain equipment load data for four different frequencies; the array subscripts (1 to 4) represent 50 Hz, 60 Hz, 400 Hz, and DC equipment, respectively. LOAD.DAT is capable of storing a unit population of up to 32,767 in a Turbo Pascal integer, which is stored in 2 bytes as shown.

5.3.3 LOAD.DAT Maintenance Procedures

a. Downloading TO&E Data from Tape

The inventory of power-drawing equipment in Army units is contained in two TO&E files maintained by TRADOC: the TO&E summary file, produced annually and containing all existing TO&Es whether in use or not and the UQSU containing only the TO&Es in current use. We recommend using the UQSU since it contains far fewer LINs.

Use a commercial tape-to-disk conversion program to read the equipment records from the TO&E tape. The data structure of the tape we used is shown in Figure 5-2. Download the SRC, LIN, and ALO Level 1 item quantity data from the tape to a data file named IMPORT.TXT. *If the numerical data are packed, be sure to unpack them in your transfer.* On the tape shown in Figure 5-2, the SRC occupies 9 bytes, the LIN occupies 6 bytes, and the Level 1 item quantity occupies 4 bytes in packed decimal format. *Your tape layout may differ.*

IMPORT.TXT will be in ASCII format; it must be converted to dBASE format to be accessible to the maintenance program. Use the dBase command *MODIFY STRUCTURE* to create a dBASE file called IMPORT.DBF with the *same* data structure used for IMPORT.TXT. Then fill the file with data from the downloaded IMPORT.TXT file using the commands:

- *USE IMPORT.DBF*
- *APPEND FROM IMPORT.TXT SDF*

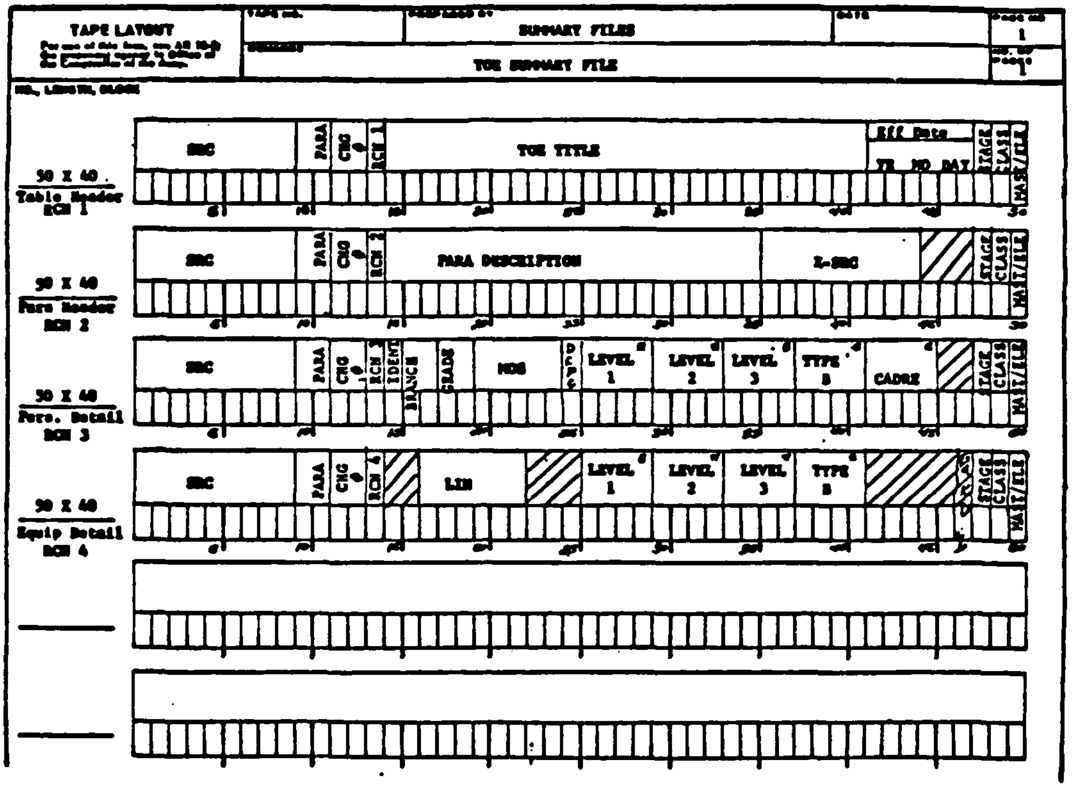


FIG. 5-2. TO&E SUMMARY FILE TAPE LAYOUT

That procedure will transfer all of the data from the IMPORT.DAT ASCII-format file into a new file called IMPORT.DBF. Both files will be of the same size; be sure you have sufficient disk space to handle them! If not, you will have to create several smaller .DBF files and join them (using the *APPEND* command) once IMPORT.DAT has been taken off the drive.

Now repeat the *MODIFY STRUCTURE* command to adjust the IMPORT.DBF structure to exactly the structure shown in Table 5-3. If your file has a different structure, PRIME's program CALC__ALL.EXE will terminate with an error message.

If you used the UQSU file for TO&E data, no further modification of the data file is needed. However, once you return to DOS, you must *RENAME IMPORT.DBF FINALLIN.DBF*.

TABLE 5-3

REQUIRED dBASE DATA STRUCTURE: FINALLIN.DBF

Field	Field name[a]	Type	Width	Dec
1	SRC	Character	9	–
2	LIN	Character	6	–
3	QTY	Numeric	5	–
Total			21[b]	

[a] Field names may differ, but type, width, and order must be identical.

[b] Total includes hidden delete field.

If you used the full annual TO&E summary file, more conversion is required in order to strip off the inactive SRCs. You will need a file of current active SRCs; the file must be in dBASE format and have an SRC character field with a length of 9 bytes. Name that file SRCTITLE.DBF. Be sure that you have the dBASE program SRCDUMP.PRG on the active disk drive (a listing of SRCDUMP is provided in Table 5-4). From dBASE, type *.DO SRCDUMP*, and get ready for a long wait. Depending on the speed of your computer, the process can take from 18 to 36 hours of continuous running.

To minimize the risk of losing data because of a power failure during this process, we have inserted a "meter" variable in SRCDUMP. That keeps track of the SRC being identified and determines how many SRCs the program will extract at one pass. The maintenance programmer needs to adjust this meter each time SRCDUMP.PRG runs. In the listing given in Table 5-4, we show the meter set to process SRCs 418 through 445. Notice that SRCDUMP also prints out SRCs for which no match was found in the summary file. Once SRCDUMP has been completed for all records in the SRCTITLE file, you will be left with a FINALLIN.DBF file.

b. Relating SRC with Electric Load Data

Once you have created FINALLIN.DBF using the procedures in Section 5.3.3, Subsection a., check to make sure you have the most recent version of LIN_CONS.DAT (see Section 5.2.1).

TABLE 5-4

SRCDUMP.PRG LISTING

```
SET ECHO ON
SET DEFAULT TO A
USE SRCTITLE
STORE 418 TO METER
DO WHILE METER<446
    GOTO METER
    STORE SRC TO MSRC
    USE IMPORT
    LOCATE FOR SRC$ MSRC
    IF .NOT. EOF( )
        ERASE SRCTEMP.DBF
        COPY TO SRCTEMP WHILE SRC$ MSRC
        USE FINALLIN
        APPEND FROM SRCTEMP
    ELSE
        USE SRCTITLE
        GOTO METER
        SET PRINT ON
        DISPLAY
        SET PRINT OFF
        CLOSE ALL
    ENDIF
    METER = METER + 1
    USE SRCTITLE
ENDDO
CLOSE ALL
QUIT
```

Your dBASE TO&E data files can be on a disk separate from the maintenance program disk since CALC__ALL will ask you to specify the input and output drives. If you decide to direct output to the input drive, make sure it has enough space. The output ASCII file will be much smaller, however, than the input file since it will have only one record per SRC while the input file has multiple records per SRC.

CALC__ALL.EXE and LIN__CONS.DAT must be in the same directory. Invoke the program by typing *CALC__ALL* after the DOS prompt. After asking you to specify the data drive, CALC__ALL checks to determine whether LIN__CONS.DAT is present and reads LIN index data from that file into RAM. CALC__ALL then reads the dBASE input file, FINALLIN.DBF, eliminates all records with nonelectric LINs (most of them), and proceeds to link data from the input file with load data from LIN__CONS.DAT and estimate peak load for each unit by using Monte Carlo simulation. Even though CALC__ALL performs a simulation with 200 runs, progress (with an IBM PC AT or faster machine) is rapid. The screen displays the program's progress as it estimates peak load for each SRC and writes those data to an ASCII output file.

CALC__ALL creates a comma-delimited ASCII output file[2] named LOADDATA.PRN. That file can easily be read into Lotus 1-2-3 for examination. Start Lotus, then enter the *file*, *input*, and *number* commands and choose *LOADDATA*. The file will occupy 14 columns and as many rows as it has records.

c. Creating LOAD.DAT

The last step is to convert LOADDATA.PRN into the static data file, LOAD.DAT, by running the maintenance program CNV__TXT.EXE. The ASCII data file FACILITY.PRN must also be present in the same directory so that LOAD.DAT includes both unit equipment and facility data. CNV__TXT concludes by sorting all records by SRC. The output file, LOAD.DAT, is the new static data file for PRIME.

5.3.4 Calculating LOAD.DAT Data

CALC__ALL removes from the dBASE input file all records whose LINs do not match the LINs in LIN__CONS.DAT. It then links the electric-load data in

[2]In a comma-delimited ASCII file, the data elements are separated by commas

LIN_CONS.DAT with the SRCs in the dBASE input file by matching the remaining LINs. CALC_ALL then uses Monte Carlo simulation to estimate peak load for each unit by SRC. The output is given by SRC; CALC_ALL aggregates data for each SRC after simulating the peak load, and the LIN data drop out.

5.4 UPDATING SRC.TXT AND INST.TXT

5.4.1 Purpose of SRC.TXT and INST.TXT

The two ASCII files SRC.TXT and INST.TXT hold the names of Army units and facilities, data not included in LOAD.DAT; those files are read by the OCONUS input routines for user "pick lists." SRC.TXT has the same SRCs as LOAD.DAT and is sorted in ascending order. INST.TXT holds facility identification codes, also from LOAD.DAT and also sorted in ascending order; the identifier "F" precedes each facility ID to distinguish it from unit SRCs.

5.4.2 Structure of SRC.TXT and INST.TXT

SRC.TXT is an ASCII static data file containing SRCs and unit names for standard Army units. The file has one record (or row) per standard Army unit, identified by its unique attribute, the SRC. The data elements are shown in Table 5-5.

TABLE 5-5

DATA STRUCTURE: SRC.TXT AND INST.TXT

Data element	Bytes
SRC/ID	9
Unit name	30
Total	39

INST.TXT is also an ASCII static data file containing the TACAPS facility identifiers and facility names for standard Army facility types. The data elements of INST.TXT are also shown in Table 5-5.

5.4.3 SRC.TXT and INST.TXT Maintenance Procedures

a. Downloading TO&E Data from Tape

Use a commercial tape-to-disk conversion program to read the table header data from the same tape from which you obtained the equipment records in Section 5.3.3, Subsection a. The data structure of the tape we used is shown in Figure 5-2. Download the SRC and TO&E title data from the tape to a data file named HEADER.TXT. On the tape shown in Figure 5-2, the SRC occupies 9 bytes and the title occupies 27 bytes. *Your tape layout may differ.*

HEADER.TXT will be in ASCII format; it must be converted to dBASE format to be accessible to the maintenance program. Use the dBASE command *MODIFY STRUCTURE* to create a dBASE file called HEADER.DBF with the *same* data structure as HEADER.TXT. Then fill up the dBASE file with data from the downloaded HEADER.TXT file using the following commands:

- *USE HEADER.DBF*
- *APPEND FROM HEADER.TXT*

That procedure will transfer all of the data from the ASCII-format file HEADER.TXT to the new file called HEADER.DBF. Both files will be roughly the same size; make sure you have enough disk space. If you do not, then create several smaller .DBF files and join them (using the *APPEND* command) once you have removed HEADER.TXT from the drive.

Now use the *MODIFY STRUCTURE* command to adjust the HEADER.DBF file to the exact data structure shown in Table 5-5. If your file has a different structure, CNV_SRC.EXE will display an error message.

If you derived your TO&E data from the UQSU file, no further modification of the file is necessary. However, once you return to DOS, you must *RENAME HEADER.DBF FINALSRC.DBF*.

If you used the full TO&E summary file, you must strip off the inactive SRCs. Use the file of current active SRCs – SRCTITLE.DBF – that you also used in Section 5.3.3, Subsection a.; it is a dBASE file with an SRC character field 9 bytes long. Make sure that you have the dBASE program SRCDUMP2.PRG on the active disk drive. SRCDUMP2.PRG is similar to SRCDUMP.PRG, except that it reads

HEADER.DBF and writes to FINALSRC.DBF. SRCDUMP2.PRG is identical in its operation to SRCDUMP.PRG; follow the instructions in the last paragraph of Section 5.3.3, Subsection a.

b. *Creating UNIT.TXT*

The last step is to convert FINALSRC.DBF into UNIT.TXT by running CNV_SRC.EXE. The temporary ASCII data file SRC_LIST.PRN must also be present in the same directory. CNV_SRC.EXE attempts to match each of the SRCs in SRC_LIST.PRN with an SRC and unit title in FINALSRC.DBF. Invoke the program by typing *CNV_SRC* at the DOS prompt. You will be asked to select a data input drive and a data output drive; they can be the same. The program will then progress without much additional user input and will terminate by displaying any mismatches.

5.5 UPDATING PRIME'S CONUS DATA FILES

The FORSCOM.DBF and TRADOC.DBF dBASE files contain peacetime population and electric consumption data for U.S. Army domestic installations with a potential mobilization mission. Those data form the foundation for PRIME's CONUS modules to calculate domestic mobilization requirements. The data structure of both files is shown in Table 3-6.

Update the files whenever significant changes have taken place in the population and mission of FORSCOM or TRADOC installations. Only two fields – the AVG_LOAD and NORM_POP fields – contain default data; the remainder are filled in by PRIME's end users when operating the model. AVG_LOAD is an installation's average electricity consumption in kW and NORM_POP is its average population. Obtain the new default data from the most recent edition of the Army's "red book," compiled by the U.S. Army Corps of Engineers.[3] Use dBASE's edit function to change the existing default values in the dBASE files. Also use the edit function to add or delete installations whenever necessary.

[3]Department of the Army; *Facilities Engineering and Housing Annual Summary of Operations*, *Vol. III*. Office of the Assistant Chief of Engineers.

APPENDIX A

ACRONYMS

ASCII	American Standard Code for Information Interchange
BERDC	Belvoir Engineering Research and Development Center
BGAP	Belvoir Generator Allocation Program
COMMZ	communications zone
CONUS	Continental United States
DA	Department of the Army
DC	direct current
DOS	Disk Operating System
EHSC	Engineering and Housing Support Center
FCZ	forward combat zone
FORSCOM	Forces Command
Hz	Hertz
IBM	International Business Machines
ID	identification
Kb	kilobyte (1,024 bytes)
kVA	kilovolt-amperes (total power)
kVAR	kilovolt-amperes (reactive power)
kW	kilowatt (real power)
LEA	Logistics Evaluation Agency
LIN	line identification number
LMI	Logistics Management Institute
MACOM	major command

MS-DOS	MicroSoft-Disk Operating System
OCONUS	outside the continental United States
OPLAN	operation plan
PC	personal computer
PC-DOS	Personal Computer-Disk Operating System
PPD	Prime Power Directorate
PRIME	Power Requirements for Installations and Military Encampments (model)
PROLOGUE	Planning Resources of Logistics Units Evaluator
RAM	random access memory
RCZ	rear combat zone
SRC	Standard Requirement Code
TACAPS	Theater Army Construction Automated Planning System
TO&E	table of organization and equipment
TPFDL	Time Phased Force Deployment List
TRADOC	Training and Doctrine Command
UQSU	Unit Quarterly Status Update
WWMCCS	Worldwide Military Command and Control System

APPENDIX B

DYNAMIC DATA FILE FORMATS

In this appendix, we explain the formats and codes used in the Power Requirements for Installations and Military Encampments (PRIME) model input and output files. PRIME creates three types of data files: two for each scenario outside the continental United States (OCONUS) and one type for both Forces Command (FORSCOM) and Training and Doctrine Command (TRADOC) within CONUS.

OCONUS DATA FILES

For each OCONUS scenario, PRIME creates both an input file and an output file. Both files must have an identical file name, with the exception of the first character. Only the third through eighth characters are optional. For example, if the input file is named *I__123456.DBF*, the output file must be named *O__123456.DBF*.

Table B-1 shows the dBASE format of PRIME's OCONUS input files. Three of the fields contain coded data, which can be deciphered as follows:

- ECHELON
  - 1 = Theater
  - 2 = Army
  - 3 = Corps
  - 4 = Division
- LOCATION
  - 1 = communications zone (COMMZ)
  - 2 = rear combat zone (RCZ)
  - 3 = forward combat zone (FCZ)

TABLE B-1

OCONUS INPUT FILE FORMAT (dBASE)

Field	Field name	Type	Width	Dec[a]	Content
1	BASE_NUM	Numeric	4	–	Program variable
2	BASE_NAME	Character	28	–	Base name
3	ECHELON	Numeric	1	–	Refer to codes in text
4	LOCATION	Numeric	1	–	Refer to codes in text
5	MOV_FREQ	Numeric	2	–	Refer to codes in text
6	HOST_NTN	Logical	1	–	Host nation support
7	UNIT_NAME	Character	28	–	Unit name
8	SRC	Character	9	–	Standard requirement code
9	UNIT_QTY	Numeric	3	–	Number of units in base
Total			78[b]		

[a] Number of decimal places.

[b] Total includes hidden deletion field.

- MOV_FREQ (movement frequency)
  - 7 = unit expected to move every 7 days or less
  - 14 = unit expected to move every 8 to 20 days
  - 21 = unit expected to move every 21 days or more.

The first three records of each input file contain scenario-specific header data rather than base and unit data. The data in those first three records must be interpreted as follows:

- Record #1
  - BASE_NAME = major command (MACOM)
  - UNIT_NAME = operation plan (OPLAN)
- Record #2
  - BASE_NAME = first comment
  - UNIT_NAME = host nation support (yes or no)

- Record #3
  - BASE_NAME = second comment
  - UNIT_NAME = security classification.

Table B-2 shows the dBASE format of the OCONUS output files. The file includes 15 fields of electric-load data by frequency, for 50 Hertz (Hz), 60 Hz, 400 Hz, direct current (DC), and total load. The total load is greater than the sum of its parts because of frequency conversion inefficiencies.

The first four records of each output file contain scenario-specific header data rather than base and unit data. The data in those first four records must be interpreted as follows:

- Record #1

  BASE_NAME = MACOM
- Record #2
  - BASE_NAME = OPLAN
  - NUM_UNITS = security classification
    - 0 = unclassified
    - 1 = secret
    - 2 = top secret
- Record #3

  BASE_NAME = first comment
- Record #4

  BASE_NAME = second comment.

CONUS DATA FILES

For each CONUS scenario, PRIME creates either a FORSCOM or a TRADOC file, depending on which MACOM you have chosen. Both files are combination input/output files.

Table B-3 shows the dBASE format of those CONUS input/output files. Unlike the OCONUS data files, none of the fields contain coded data.

TABLE B-2

OCONUS OUTPUT FILE FORMAT (dBASE)

Field	Field name	Type	Width	Dec[a]	Content
1	BASE_NUM	Numeric	4	–	Program variable
2	BASE_NAME	Character	28	–	Base name
3	ECHELON	Numeric	1	–	Refer to codes in text
4	LOCATION	Numeric	1	–	Refer to codes in text
5	MOV_FREQ	Numeric	2	–	Refer to codes in text
6	NUM_UNITS	Numeric	3	–	Total units in base
7	POPULATION	Numeric	7	–	Base population
8	H50_KW	Numeric	11	3	Peak load – 50 Hz
9	H60_KW	Numeric	11	3	Peak load – 60 Hz
10	H400_KW	Numeric	11	3	Peak load – 400 Hz
11	DC_KW	Numeric	11	3	Peak load – DC
12	TOT_KW	Numeric	11	3	Peak load – Total
13	H50_PF	Numeric	5	3	Power factor – 50 Hz
14	H60_PF	Numeric	5	3	Power factor – 60 Hz
15	H400_PF	Numeric	5	3	Power factor – 400 Hz
16	DC_PF	Numeric	5	3	Power factor – DC
17	TOT_PF	Numeric	5	3	Power factor – Total
18	H50_MAXKW	Numeric	7	3	Largest single load – 50 Hz
19	H60_MAXKW	Numeric	7	3	Largest single load – 60 Hz
20	H400_MAXKW	Numeric	7	3	Largest single load – 400 Hz
21	DC_MAXKW	Numeric	7	3	Largest single load – DC
22	TOT_MAXKW	Numeric	7	3	Largest single load – Total
23	HOST_NTN	Logical	1	–	Host nation support
Total			163[b]		

[a] Number of decimal places

[b] Total includes hidden deletion field.

TABLE B-3

CONUS DATA FILE FORMATS

Field	Field name	Type	Width	Dec[a]	Field name
1	FORT_ID	Numeric	3		Program variable
2	FORT_NAME	Character	30		Installation name
3	AVG_LOAD	Numeric	10	1	Peacetime average load
4	PEAK_LOAD	Numeric	10	1	Peacetime peak load
5	MOB_LOAD	Numeric	10	1	Mobilization peak load
6	MAX_LOAD	Numeric	10	1	Substation capacity
7	BACK_LOAD	Numeric	10	1	Back-up capacity
8	PP_REQT	Numeric	10	1	Prime-power requirements
9	NORM_POP	Numeric	10		Peacetime population
10	MOB_POP	Numeric	10		Mobilization population
Total			114[b]		

[a] Number of decimal places.

[b] *Total includes hidden deletion field.*

APPENDIX C

PRIME METHODOLOGY: SAMPLE CALCULATIONS

In this appendix, we illustrate the Power Requirements for Installations and Military Encampments (PRIME) methodology using two sample calculations: one for outside the continental United States (OCONUS) and another for CONUS.

SAMPLE OCONUS CALCULATION

We have limited our sample calculation to the calculation of peak load for one base since the methodology is the same no matter how many bases are involved. The first step in running the OCONUS portion of PRIME is to enter data for Army bases that may need electric power, such as the partial sample data shown in the first four columns of Table C-1.

When the user enters the base-specific variables – base name, echelon, location, and movement frequency – PRIME assigns an internal variable (a base number) to each record for that particular base. The base number is shown in Column 1 of Table C-1. (The value of the base number is irrelevant; it represents the order in which PRIME received the base inputs.) PRIME uses the base-specific variables to sort the output records for display; it also uses the base number to distinguish among bases when calculating peak loads for each base.

The next three columns of the table show the unit-specific variables: the unit name, the Standard Requirement Code (SRC), and the number of units of a particular type in that base (unit quantity). The SRC is the link between PRIME's data files.

Once the user has entered base/unit data (via the Input/Edit Module or the Import dBASE Module), the next step is to invoke the OCONUS Run Module. That module links the input file (I_nnnnnn.DBF) with a pre-existing data file (LOAD.DAT) containing electric-load data for specific Army units. Tables C-2 and C-3 display actual data from that pre-existing data file. In order to link the input file with the data file, PRIME searches for a match between the SRC in the first record of the input file and an SRC in the data file. Table C-2 illustrates the result of that search. PRIME finds a match at record number 58 and reads the following unit

TABLE C-1

DATA LINK BETWEEN INPUT (.DBF) FILE AND DATA (.DAT) FILE

Base data from I_nnnnnn.DBF				Data from LOAD.DAT			Calculated data	
Base no.	Unit name	SRC[a]	Unit quantity	kW	kVAR	Max. kW	Qty. X kW	Qty. X kVAR
1	Bridge Company - Ribbon	05148J210	2	10.592	0.975	3.360	21.184	1.950
1	FA Btry, 105mm towed	06117H000	1	6.198	0.724	1.453	6.198	0.724
1	Medical Ambulance Company	08127H410	6	7.022	1.005	1.428	42.132	6.030
1	Station Hospital, 300 bed	08233H700	1	148.899	1.180	45.119	148.899	1.800
1	MP Escort Guard Company	19047H400	5	3.622	0.000	1.500	18.110	0.000
1	MP Guard Co.	19247H400	3	9.223	0.000	4.800	27.669	0.000
1	Heavy Maint Co., Maint Bn	29089J000	2	78.255	26.318	21.554	156.510	52.636
1	General Supply Co., Gen Spt	29118H100	1	61.558	17.947	12.397	61.558	17.947
1	Rep Parts Supply Co., GS Corps	29119H510	4	102.386	18.773	12.770	409.544	75.092
1	Ammo storage	F 42183AA	5	0.350	0.000	0.000	1.750	0.000
1	Chapel	F 74018AN	1	3.200	0.000	0.000	3.200	0.000
1	Post Office	F 74059AF	1	17.640	0.000	0.000	17.640	0.000
1	Medical depot	F GH4019	2	69.600	0.000	0.000	139.200	0.000
Total							1,053.594	155.559
Maximum						45.119		

[a] SRC is the link between I_nnnnnn.DBF and LOAD.DAT; it is in both

variables from LOAD.DAT: the peak power [kilowatts (kW)], the reactive power [kilovolt-amperes (kVAR)], and the highest single load (maximum kW). Those variables and their values are shown in Columns 5 through 7 of Table C-1.

Table C-3 illustrates the remaining records that PRIME must find in LOAD.DAT to match with the SRCs in the input file. PRIME then reads the unit load variables associated with those records; their values are also shown in Columns 5 through 7 of Table C-1.

As shown in Table C-1, PRIME multiplies the peak power (kW) and reactive power (kVAR) variables by the unit quantity for each unit. It then sums the total kW and total kVAR for the base as a whole. The maximum load is the highest single load, in this case 45.119 kW.

TABLE C-2

SEGMENT OF DATA FROM LOAD.DAT DATA FILE
INCLUDING FIRST SRC MATCH

Record number	SRC	kW	kVAR	Max. kW
55	05146J200	32.811	2.292	7.214
56	05146L000	19.075	2.596	3.524
57	05147J200	12.795	2.904	2.030
58	*05148J210*	*10.592*	*0.975*	*3.360*
59	05153L000	10.732	1.507	3.548
60	05156J800	9.836	1.222	0.805
61	05157H700	6.858	1.504	1.416

TABLE C-3

REMAINDER OF SRC MATCHES FROM LOAD.DAT DATA FILE

Record number	SRC	kW	kVAR	Max. kW
101	06117H000	6.198	0.724	1.453
187	08127H410	7.022	1.005	1.428
194	08233H700	148.899	1.180	45.119
346	19047H400	3.622	0.000	1.500
352	19247H400	9.223	0.000	4.800
380	29089J000	78.255	26.318	21.554
391	29118H100	61.558	17.947	12.397
392	29119H510	102.386	18.773	12.770
571	F.42183AA	0.350	0.000	0.000
581	F.74018AN	3.200	0.000	0.000
583	F.74059AF	17.640	0.000	0.000
601	F.GH4019	69.600	0.000	0.000

Finally, PRIME calculates the following variables for the base as a whole and displays those shown in italics:

- Theta = arc tan [(total kVAR)/(total kW)] = arc tan (155.559/1053.594) = 0.147 radians
- *System power factor* = cos (theta) = cos (0.147) = *0.989*
- Maximum item = largest single draw = maximum (0.000 . . 45.119) = 45.119
- *Surge percent* = (maximum item)/(total kW) = 45.119/1053.594 = *4.2 percent.*

SAMPLE CONUS CALCULATION

We have limited our sample CONUS calculation to the calculation of peak mobilization load for one installation since the methodology is the same no matter how many installations there are.

PRIME reads data on normal peacetime installation electric loads and populations from the pre-existing data files FORSCOM.BAK or TRADOC.BAK. Our sample installation has a normal population of 22,737 and an average electrical load of 17,126 kW.

The user is asked to enter three peacetime variables – normal peak load, maximum substation capacity, and available auxiliary generator capacity – and one mobilization variable – expected population at mobilization. We shall assume that those variables have the following values:

- Normal peak load = 22,250 kW
- Maximum substation capacity = 35,000 kW
- Auxiliary generator capacity = 500 kW
- Expected mobilization population = 250,000.

From those data, PRIME estimates the total electric load at mobilization as follows:

Mobilization peak load = peacetime fixed factor + wartime variable factor × mobilization population = 2,809 + 0.10 × 250,000 = 27,809 kW.[1]

Because of the limited precision of the fixed and variable factors, PRIME rounds that value to the nearest 100, in this case 27,800 kW. Using that value, PRIME estimates the required prime-power capacity as follows:

Prime-power requirement = mobilization peak load − max substation capacity − auxiliary power = 27,800 − 35,000 − 500 = 0.0[2]

Rather than displaying the calculated prime-power requirement for each individual installation, PRIME totals the prime-power requirement for the entire major command (MACOM). Unlike the OCONUS model, the CONUS results are statistically reliable only for the MACOM as a whole.

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[1] If mobilization population is less than the normal population or mobilization peak load is less than normal peak load, then mobilization peak load = normal peak load.

[2] If the maximum substation capacity plus the auxiliary generator capacity is greater than the mobilization peak load, then the prime power requirement = 0.0.

APPENDIX D

CALCULATING THE PEAK LOAD FACTOR

To calculate a peak load factor that would be valid for Army bases in emergency situations, we used data from combat experience in Vietnam in 1968.[1] Table D-1 shows the data and our method of calculating the peak load factor. (Table D-2 identifies the bases included in the study.) The peak load factor is simply peak load divided by connected load. The total peak load for each base was the maximum point on a 2-day demand load curve. We adjusted the total connected loads for each base by subtracting the receptacle connected loads since they are highly variable. Had we left receptacle loads in the calculation, the average peak load factor would have been 46.5 percent; excluding receptacle loads, the average peak load factor is 63.5 percent. The latter number is closer to industrial peak load factors, and appears to be a more reasonable estimate. Despite the range of base types and sizes included in the electrical survey, the peak load factor was remarkably consistent; the standard deviation was only 5.1 percent. The individual peak load factors in the sample ranged from a low of 56.5 percent to a high of 69.8 percent.

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[1] *Electric Load Data, Seven U.S. Army Bases*, Office of the Chief of Engineers, Department of Army Contract No. DACA-73-68-C-0014. Keller & Gannon Consulting Engineers, May 1969.

TABLE D-1

VIETNAM BASES: PEAK LOAD CALCULATION

(kVA)	Bases						
	1	2	3	4	5	6	7
Peak load	1,235	9,460	3,069	1,952	10,048	582	579
Connected load							
Lighting	494	3,216	2,982	1,751	3,927	357	218
Ventilation	73	576	3	3	130	53	3
Refrigeration	209	5,109	195	102	1,650	42	121
Hot water	34	749	384	29	473	20	216
Other	960	4,147	924	1,212	10,385	544	466
Subtotal	1,770	13,797	4,488	3,097	16,565	1,016	1,024
Peak factor	69.8%	68.6%	68.4%	63.0%	60.7%	57.3%	56.5%
Average peak load factor	63.5%						
Standard deviation	5.1%						
Receptacle load	678	3,357	2,580	2,017	3,845	420	162
Total	2,448	17,154	7,068	5,114	20,410	1,436	1,186
Peak factor	50.4%	55.1%	43.4%	38.2%	49.2%	40.5%	48.8%
Average peak load factor	46.5%						
Standard deviation	5.6%						

TABLE D-2

VIETNAM BASES INCLUDED IN STUDY

Number[a]	Location	Type
1	Phu Loi	Army aviation base
2	Long Binh	Command facility
3	Chu Lai	Americal infantry division
4	Camp Enari, Pleiku	Infantry division base camp
5	Cam Ranh Bay	Logistic support base
6	Phuoc Vinh	Brigade base camp
7	Pleiku	Evacuation hospital

[a] From Table D-1.